Journal of Research on the Lepidoptera 3 (1) :5-8, 1964

1140 W. Orange Grove Ave., Arcadia, California, U.S.A.

DECAPITATION-INITIATED OVIPOSITION IN CRAMBID MOTHS

CLIFFORD S. CRAWFORD
Portland State College,
Portland, Oregon

THE MEAGER LITERATURE on decapitation-initiated oviposition in insects has been partially reviewed by Chiang and Kim (1962) who observed the phenomenon in crane flies. M'Cracken (1907) had previously shown that mated female silkworm moths exhibit an early oviposition response to abdominal stroking when decapitated; however spontaneous egg production was rare following head removal.

It has been observed in a number of instances that certain insects tend to oviposit in response to being trapped or wounded (Harwood, personal communication, 1963), yet there is little doubt that an inhibitory center in the subesophageal ganglion does exert a controlling effect on oviposition (Roeder, 1963). An opportunity to study the behavior of certain microlepidoptera with regard to the inhibitory role presumbably played by this ganglion over endogenous oviposition activity recently presented itself; the following being a report of some preliminary work suggesting areas where the nature of the control could be more fully explored.

In a study of the reproductive biology of lawn moths in the family Crambidae it was found that decapitation of gravid females brought about oviposition generally within ten minutes for fall-generation *Crambus bonifatellus* Hlst. and *Euchromius californicalis* (Pack.), the two species then available. Tactile stimulation following decapitation was not necessary to induce egg deposition. Decapitation was performed with a pair of fine scissors after moths had been cooled to sluggishness. Immediately following the operation the headless moths stood quietly, and shortly thereafter the terminal part of the abdomen began to undergo rhythmic contractions which continued during oviposition. In some cases the entire abdomen vibrated in a vertical plane as well. Decapitated male moths also exhibited abdominal contractions and periodically expanded their genitalia. Moths of both sexes showed no tendency to mate when held together in different positions after decapitation. The effects on oviposition activity of inflicting gross injury without damaging the subesophageal ganglion or nerve cord have not yet been investigated.

The time interval between head separation and oviposition proved variable for *C. bonifatellus*, the most abundant crambid and the only one used experimentally. Under room conditions, individuals of a group of ten females caught at light took from 50 seconds to nine and a half minutes to begin laying eggs after the operation. Directly after beginning to lay, these moths were dissected and subsequently divided into three classes according to the relative amount of eggs and fat body in the abdominal cavity. Since there was an obvious lack of correlation between abdominal class and time intervals concerned, it would appear that within about ten minutes after decapitation any mechanical pressure responsible for moving eggs out of the reproductive tract is not a direct function of the degree of gravidness.

In order to determine whether the circadian oviposition rhythms known to occur in these species (unpublished data) are maintined by headless moths, a number of decapitated *C. bonifatellus* females were exposed to darkness at 28.0 ± 1.4°C and their eggs collected in a manner previously described (Crawford, 1962). The resulting oviposition was sporadic, and though eggs were generally laid in batches, there was no semblance of the usual diurnal rhythm. This result is consistent with Harker's (1955) finding that subesophageal gland neurosecretory cells are responsible for activity rhythms in the American cockroach, *Periplaneta americana* L. It is therefore to be expected that successful subesophageal gland implanation into headless crambid females may re-establish the rhythm.

The decapitated crane flies used by Chiang and Kim (1962) laid a greater percentage of fertile eggs than did controls, though it was not indicated whether this difference was statistically significant. In the present study crambid eggs were also tested to see if egg fertility was affected by decapitation. Twenty moths obtained from light (and therefore of unknown age) were cooled for at least 24 hours at about 5°C, then half of these were decapitated while cold. The other ten were used as controls. All moths were incubated at 28.6 ± 2.5°C in petri dishes at the bottom of which were moist circular pieces of blotting paper. Decapitated females were not as physically active as controls, and remained alive (in the sense that they were capable of body movement) an average of 3.9 ± 0.5 days, which was not significantly different from the 5.1 ± 0.5 days lived by controls. No records were kept of daily oviposition by individuals, but it was obvious that some decapitated moths laid for at least 48 hours. In calculating final percentages of fertility, eggs which remained yellow or slightly pink a week after being laid were considered infertile, while eggs obviously about to hatch but in danger of being eaten by cannibalistic larvae were considered fertile.

Out of a total of 506 eggs laid by headless moths 11.1% were infertile, while 22.6% of the 974 control eggs were infertile. A chi square analysis of the pooled experimental data using controls as standard indicated the difference in fertility was highly significant ($X^2 = 52.28$, 1 d.f.) However a chi square analysis of heterogeneity (Snedecor, 1956) which was prompted by obvious differences in egg fertility among individuals was also significantly high ($X^2 = 93.91$, 8 d.f.) The data therefore suggest that while decapitation may have had a positive effect on fertility, it would take a decidely larger number of moths to show clearly that this is true.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. Q. D. Clarkson, Portland State College, and Dr. R. F. Harwood, Washington State University, for critical advice given during preparation of the manuscript. For his assistance in obtaining specimens Mr. Peter F. Murray is also cordially thanked.

REFERENCES CITED

CHIANG, H. C. and Y. H. KIM. 1962. Decaptation-initiated oviposition in crane flies. *Ent. Exp. and Appl.* 5: 289-290.

CRAWFORD, C. S. 1962. An apparatus for measuring oviposition in some insects. *Northwest Sci.* 36: 123-125.

HARKER, J. E. 1955. Control of diurnal rhythms of activity in *Periplaneta americana* L. *Nature, London.* 175: 733.

HARWOOD, R. F. 1963. Personal communication.

M'CRACKEN, M. 1907. The egglaying apparatus in the silkworm (*Bombyx mori*) as a reflex apparatus. *Jour. Comp. Neurol. and Psychol.* 17: 262-285.

ROEDER, K. D. 1963. *Nerve Cells and Insect Behavior.* Harvard University Press, Cambridge, Mass. 188 pp.

SNEDECOR, G. W. 1956. *Statistical Methods.* 5th edition. Iowa State College Press, Ames, Iowa. 534 pp.